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## THE IMPORTANCE OF COST-KEEPING TO THE MANUFACTURER

Shop economics is a subject which has, of recent years, received a great amount of attention from various writers. All of the important engineering and technical journals are devoting many of their pages to the discussion of this important subject. It has been discussed with more or less ability, in all its phases and details.

In order that the manufacturer may secure maximum production at a minimum expense, it is absolutely essential for him to know what his product is costing him. Not only is it essential to know the gross *cost*, but he must also know the cost at each stage of production. The three important divisions of the cost of any manufactured article are: Labor, material and general expense. The simple record of time and wages, in the pay-roll book, might appear to be sufficient as far as labor is concerned. If the subject be carefully analyzed, however, two very important subdivisions of labor will be found, namely: Productive and non-productive. Productive labor is the labor expended in actually producing something. Non-productive labor is the labor which is not directly chargeable to some specific factory or production order. Each of the above elements of labor can be analyzed into other elements of importance.

To a person unfamiliar with the subject, a cost sheet might be looked upon as something valuable merely as a means of determining or fixing a selling price for a given product. While this is, of course, one of its functions, the general information it places in the hands of the manager is of no less importance. In the analysis of time and wages the cost account should so record all the factory expenditures as to enable the manager to be always ready to place his finger upon any unusual, or seemingly exorbitant, item of cost or expense.

In dividing productive labor, the time and wages should be recorded as follows:

In the first place, it should be charged to its respective factory, or production order, and then to the component of that order on which it was expended. If the mere fixing of a selling price for present and future articles were all that was required, this would be far enough to carry the analysis; but its advantages will be much

greater if the analysis be carried still further. The time expended and wages incurred on each operation should be fully recorded. For instance, if one of the components of an order was a cast spur gear, the operations on this gear would be, in their proper sequence, as follows: Boring, facing hubs, keyseating, and drilling and tapping for set-screws. It is obvious that should the total time for these four simple operations be recorded as a lump sum of time and money, the manager would not be so well able to locate errors as he would if the time and wages were charged against each operation. It is equally apparent that if proper use was made of the information so recorded, as by comparison of different records for the same or similar operation, the manager would be enabled to see where leaks occur, and take steps to reduce subsequent costs, providing better methods or more skilled men could be found.

Besides, the cost reduction that could be accomplished on subsequent orders, it is also possible to hold down cost of operations on running orders whose components contain elements of time greater than those enumerated above. To accomplish this, it is absolutely necessary that all time and wages be entered in their proper places not later than the morning of the day following their expenditure. All of this demands hearty co-operation between the shop manager and the cost-keeper. The cost-keeper finds and points out the high cost, and the manager locates the cause and applies the remedy.

Turning now to the consideration of cost-keeping for non-productive labor, this must be subdivided into the various charges of expense, namely: Superintendence, foremanship, clerk hire, repairs, maintenance, power, heat, lighting, etc. This work of subdivision may be carried out to any degree of refinement desired. The finer these elements are subdivided the easier it will be for the manager to correct errors and reduce costs.

The consideration of these two important divisions of labor has thus far been in connection with the whole plant. In an establishment where but one manufacturing department exists, or one class of work is performed, this is sufficient, but, as most manufacturing consists of several separate and distinct classes of work, it is necessary to analyze still further.

Take, for example, a plant where it is necessary to maintain the following departments: Smith shop, machine shop and pattern shop. By careful thought, one can readily reason that the burden

of expense will be much greater in some of these than in others. For instance, take the smith shop with its equipment of steam hammers, forges, furnaces, formers, dies and miscellaneous small tools. These, while low in first cost as compared with the expensive equipment of the machine shop are relatively high in the cost of maintenance, due to rapid depreciation by reason of the severe duty to which they are subjected.

By such a line of thought it is easy to decide that it is important to fix, by a proper system of accounting, the relations between "productive" and "non-productive labor" of each department. Without such a division, it would be impossible to tell whether or not all of the departments were paying investments. The business, as a whole, might show a profit, but if such an analysis were made, some startling conditions might appear. The smith shop might show up in such a manner as to prove, conclusively, that it were better to abandon it altogether and buy the forgings, or to make further investment in equipment and management to cheapen production.

To describe the forms and methods necessary to accomplish this accounting for labor, would require more space than the writer has at his disposal. Briefly, a time card must be made for each operation a workman may perform on a component. This time card should bear the date, workman's name, number or name of machine, production order number, name or symbol of component, number or name of operation, number of pieces finished, time of starting, time of finishing, elapsed time, rate per hour, and total wages. These cards should be posted on the cost sheets not later than the day following the work.

Next in importance to the accounting for money expended upon labor, is the accounting for that expended upon materials, raw and finished. When considering the subject of cost-keeping, it is necessary to include all the divisions of shop accounting. This is true because it is in this department that the results of all accounting find their final use, and it is from here that the utility of all is made apparent. The keeper of rough and finished stores must make his final returns to the cost department, and then, in turn, they are charged to the order or item to which they belong. All material spoiled when received, or in handling in process of manufacture, must be properly accounted for, and finally charged where it truly belongs.

There are many manufacturing plants that are, to a casual observer, run on very improved methods, and which, while they are probably paying dividends, could very materially increase these dividends by simply keeping the floors clear of bolts and such other small items of stock as become buried in the accumulated litter, and which finally find their way to the scrap heap when the great day of house cleaning comes around. The value of a careful and correct system of stock accounting, and clean floors, was recently illustrated by the president of one of Philadelphia's important industrial establishments. He asked the following questions of one of the foremen who had allowed the floors of his department to become covered with bolts and similar small articles of stock. His questions were: "Have you ever visited the United States Mint?" The foreman's reply was: "Yes!" "Well, then," said the employer, "did you see any pennies, nickels, or dimes lying about the floor?" "No, sir," answered the foreman. The employer then asked, "Do not these bolts, etc., represent pennies and dimes, and should they not be placed where they can be made to show their value and become an asset to the company instead of just so much rubbish?" There is but one answer, for every cent expended in a manufacturing establishment for anything that is not at all times available as an asset, or properly accounted for, becomes just so much of a reduction to the profits of the business. In addition to this, the bad effect of such a system of slovenly management is very far-reaching in its influences on the employees.

In a certain large plant, where a pressed steel product is manufactured, the care taken to account for the scraps of steel is most impressive to any one interested in cost-keeping. At these works every pound of steel is followed with its own dead, or flat, cost price until it finds its way into the finished product. By this means all steel is charged against the product into which it enters, at exactly the pound price paid for it from the mill. In addition to this each order is charged with exactly the amount of scrap made necessary to produce it, and in this way the cost of the product is as near correct as it is possible to make it, so far as the material side is concerned. The scrap is treated as a by-product, and, when sold, it is credited to manufacture. No investigation of the method of accounting for the time was made, but I believe it fair to assume that it is equally as well taken care of as the material, inasmuch as the general

manager stated that he had recently compared the shop accounting with the commercial accounting for a period of six months, and had found them to balance within \$98. This is certainly excellent when one considers that the business for these six months had amounted to many thousands of dollars. This result is even more astounding when one realizes that but four clerks were employed on cost work, one of these being the cost-keeper himself.

In considering the accounting for material in connection with any cost system, it would be well to keep the above illustration in mind, as it is, in the writer's judgment, about as near perfection as it is possible to reach.

When considering the subject of general expense, it is to be recommended that each article manufactured should bear its proportionate amount of this expense. This general expense should be divided into expense of administration, fixed charges, and general shop supplies. It is desirable, as a subdivision of the fixed charge cost account, to keep a machine cost sheet, and in this way make each article carry very closely its proper amount of general expense.

In order to consider the reasons for this, it is necessary to examine the other method of distributing this expense over the costs, namely: the fixing (by deductions from figures previously compiled) a percentage of the total productive wage bill which will cover the total non-productive labor and general expense.

After this percentage has been decided upon all productive labor is made to bear this percentage, and in that way the amount is charged up to the cost of each piece.

Example:

$$\begin{array}{rcl} 2 \text{ Hours @ } 30c. & = & .60 = \text{dead cost} \\ 50\% & = & .30 = \text{general expense, etc.} \\ \hline & & .90 \text{ Mf'd cost.} \end{array}$$

Let us now suppose that the above two hours were turned in by a man working on a four thousand dollar (\$4,000) boring mill. This mill, in addition to the first cost, would require considerable time and money expended for maintenance and a valuable collection of small tools and accessories, together with power used and floor space occupied. All that would be charged to this work would be thirty cents (30c.) to cover the above.

The other extreme to this would be a man working on floor work with a hammer and chisel. He, too, works two hours, rate also thirty cents per hour. The cost of his work would be figured as follows:

$$\begin{array}{rcl}
 2 \text{ Hours @ } 30c. & = & .60 = \text{dead cost} \\
 50\% & = & .30 = \text{general expense, etc.} \\
 \hline
 & & .90 \text{ Mf'd cost.}
 \end{array}$$

Here again we have thirty cents (30c.) charged to cover the general expense, depreciation, etc. In one case the man using an equipment representing a large investment, and in the other, one that costs but very little. It is obvious that such a method will make the costs much too low in one case and much too high in the other. The safer and better way is to fix an hourly rate to cover each machine in the shop and then finally a percentage to cover that expense which is not directly chargeable to the machines, and add this percentage to all labor, whether hand or machine. In this way the general expense will be properly placed against the work to which it belongs.

There are many cases where too much detail is gone into and too much system applied; and in them the ability of the manager will be first apparent. He will know just how much refinement his business requires, and, finally, after he gets it, he will know how to apply it to an advantage. Why should a manager waste his time running about the plant looking up trifling details, making himself—and in the majority of cases the people who are paying him a large salary—believe that he is a much overworked man, and finally end in having an assistant to help him in this never-ending search for information, which, even if they find it, will never be put in proper form to be of future use. By this line of argument, it is not purposed to advise, or even hint, that a manager should not give his attention to details, but, on the contrary, to say *most emphatically*, that he should have a system of correct forms and a trained force of clerks to collect this data, and day in and day out, present to him, in their proper sequence, the facts relative to these details of his business, so that he may make his comparisons and thereby cheapen his production, hold down the running expenses of his business, and readjust his employees' wages.

The readjustment of wages is a very important detail in connection with any business. A capitalist does not invest his money in a miscellaneous lot of securities and enterprises and then, because on the whole he makes money, lose sight of them individually. He keeps his eye on each one, and knows exactly whether this one pays, or that one does not pay. When he finds one that does not pay, he rids himself of it as soon as convenient and with as little loss as possible. A number of employees paid wages for performing certain duties are just so many investments of capital, and they should be accounted for just as carefully as stocks, bonds and like securities. A manager cannot adjust wages with judicial fairness if he has not always before him a personal account with each man employed, and he cannot have this record unless he has a complete system of cost accounting. He will never accomplish this, as so many hope to do, by simply making trips through the shop or factory and making an observation of first this or that man, and saying to himself, "Well, 'Smart' is certainly a first-class man, but 'Steady' is only fair." Take such an observation, for example, as to the fairness of this style of keeping a record of individual workmen. "Smart" is the man who is always on the lookout for the "Boss," and can generally be relied upon to tell you correctly, if you are on the hunt for that individual, where to find him, or at least the direction in which he was traveling five minutes ago. He always knows whether the "Boss" is where he can see him, and whether he is observing what he, "Smart," is doing. What is the result? Whenever the "Boss" is looking, "Smart" puts on an extra spurt, makes a great pretence of fast work and close application to duty, and keeps this up just as long as he is being observed; but as soon as the "Boss" turns his eyes, or has passed out of observing distance, "Smart" puts just as much energy into figuring out where and when he is likely to turn up again. In consequence his day's work is made up of a few spurts, and a tremendous amount of energy expended in figuring out how to fool the "Boss."

What about "Steady"? He is working right beside "Smart," but he is attending assiduously to his work and minding his own business, and doesn't even know that he is being observed. There is no apparent rush or hustle about his work, and none of the seeming speed or vim that we have noticed in "Smart," at this particular moment, and he must naturally appear at a decided disadvantage



beside his shopmate "Smart." The result of the observation, in the mind of the "Boss," then is, as described above, that "Smart," is a first-class man, and "Steady" is only a fair one. When the day for raising wages comes around—and such managers generally have a certain time for raising wages—"Smart's" pay is increased and "Steady" is left at the same old rate, and after a sufficient number of observations, he is probably dropped altogether, and the manager proceeds to look for another "Smart." It is evident that such a method of judging the value of men is very unjust and very detrimental to the business. Should a manager persist in weeding out his men, on this basis, he will finally wind up by having a shopful of what may be termed "professional loafers," to whom he is paying high wages because they deceive him.

A correct system of cost accounting will present to the manager a daily, a weekly, or monthly statement of the work done by each employee, in such form as to enable him to make comparisons and deduce the facts relating to any particular individual. It is surely evident that such a method of judging men is infinitely more just, safe, and effective than the one previously described.

Having examined the two methods of considering a workman's value on the basis of the use he makes of the time for which he receives pay, let us now consider how best to trace and account for the equipment, small tools, accessories, and material that are sure to be in his care during his term of service. It is important that the manager account for every dollar invested, either in plant or material. This cannot be accomplished by a system of journeys of observation through the plant, any more than he can account for the workman's time by such a system. He must have a system of standards in his tool room and shop, and must maintain this system of standards by locating, at all times, any violation thereof. By this I mean, that he must have a predetermined stock of small tools in his tool room and these small tools ground to correct angles and shapes. When one of these tools is injured, either as to angle or shape, or perhaps broken, this system should tell him, beyond a question of doubt, who is at fault, and the cause for such damage. Without a thorough system of accounting, the system of standards will soon be destroyed.

This has been called "The age of intensified production," and this is surely true, for, no matter where you go, you will find manufacturers making heroic efforts to keep up with the tremendous

pace set by some more energetic and systematic competitor. This being true, it is evident that he must, of necessity, keep a very close track of all the small details of his business.

A few years ago a machinist would be fined for wearing out a tool. To-day the wise manager pays the man a premium for wearing it out—with the proviso, of course, that he accomplishes the work that the tool is capable of performing. Take, for instance, a lot of small sprocket wheels which have to be drilled. By careful analysis it is found that it will pay to run the drills so fast that each drill press will completely use up one drill in a day of nine hours, in spite of the fact that twice as many holes could have been drilled by each drill used at two-thirds this speed. This could not have been determined except by a correct system of cost accounting.

A few years ago the machine-shop manager paid seven cents per pound for his tool steel, and nursed both machine and tool. To-day he pays seventy cents per pound for tool steel, and drives both to the limit of their endurance. It would not be possible to determine such a great problem of shop economics by any loose system of accounting. He must know exactly what all this extra expenditure of money and energy is bringing him in return, in order to ascertain whether he is being repaid for his trouble and expense.

Going back again to tools: In the days of seven-cent tool steel, an ordinary round nose roughing tool cost forty-five cents up to a dollar and twenty-five cents, according to the section and length of the tool. To-day, when paying seventy cents for tool steel, the same style of tool costs, with its special treatment, from three dollars and seventy-five cents up to as much as, in some cases, ten dollars. It is apparent that the manager should know just what each of these tools is doing, and what becomes of them. This can only be accomplished by a proper check system in the tool room, and this check system must, in turn, be rigidly enforced. This check system should be of such a nature that it will fix the location of any tool, and the length of time it has been so located. What is true of the cutting tool is also true of all the other small tools, and likewise true of the equipment. The system must record the cost of material as well as the labor entering into the various items of expense.

In an establishment paying its employees by any of the various piece-work plans, it is to the cost department that the manager will

turn for information upon which to base his rates. In many establishments operating under a piece-work system, the cost-keeper is the man who fixes the rates. In all well-regulated plants he is the person who records all such transactions with the men, and sees to it that the workman receives his pay when the contract is completed. He not only records piece-work time and wages, but has direct supervision of all time-keeping and payment of wages.

Mr. Frederic W. Taylor, the pioneer and foremost inventor of advanced systems of shop management has, in his plan of functional foremanship, considered the cost-keeper of such importance that he has made him one of his functional foremen. He has given him direct charge of the men, and made them directly responsible for all matters pertaining to time and cost. This leads to another line of thought. If a manufacturer decides to install a system of cost and factory accounting, and places a man in charge of the same, the cost-keeper will proceed to collect data and information, but he will be unable to make this data of any real value unless he is given the proper amount of authority to apply the facts so ascertained. No one can ever accomplish any real good if he is compelled to apologize to some one, at every turn, for having exceeded his authority. He must, of course, have respect for vested authority wherever he finds it, but he must also have sufficient authority vested in him to enable him to accomplish the desired end. If this is not the case, he would be very much in the position of a jockey who might be placed astride of a race horse and told to win the race, but on no account to use whip or spur. His only means would be gentle persuasion, and when the pace became hot he would fall behind, finish in the rear, or, perhaps be distanced altogether.

To sum up all this, the cost-accounting department must record all information relative to time and material, so as to be a means toward the end of reducing costs and expenses, and then, after such records are made, to assist in their application toward that end. The qualifications of the head of such a department have been well stated in the following quotation from Mr. Gunn's article on "Cost-Keeping; a Subject of Fundamental Importance":

"Cost-finding is not merely the work of an accountant, no matter how competent he may be. It is the work of an engineer, supplemented by the best accounting knowledge he can command. The engineer, in turn, must be possessed of an executive faculty

to such a high degree that he shall be able to create and administer an organization which not only finds but shall continue to find costs. Having found costs, this executive must be possessed of a sufficiently broad knowledge of that portion of the industrial world to which he is related, to be able to use the information which he has, and to preserve such an organization as will insure facts for each succeeding month or year being presented in like manner with those first compiled, so that he may receive the full benefit of comparison. For costs have no value except in comparison, that action may be directed by experience."

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